Exemption No. 7104

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of

Dassault Aviation

For an exemption from § 25.785(a) of
Title 14, Code of Federal Aviation Regulations

Regulatory Docket No. 29583

PARTIAL GRANT OF EXEMPTION

By letters reference #DGT/NAV 543.826, dated May 4, 1999, reference #DGT/NAV 242.659, dated June 16, 1999, and reference #DGT/NAV 244.400, dated September 9, 1999, Mr. Michel Aguado, Manager, F2000 Certification, Dassault Aviation, Direction Generale Technique, BP 24, 33702 Merignac Cedex, France, petitioned for exemption from § 25.785(a) Title 14 Code of Federal Regulations (14 CFR), as amended by Amendment 25-64. The proposed exemption, if granted, would permit relief from the general occupant protection requirements for multiple place side-facing seats on the Falcon Model 2000 airplanes.

The petitioner requests relief from the following regulation:

> Section 25.785(a), Amendment 25-64, requirements for general occupant protection for occupants of multiple place side-facing seats that are occupied during takeoff and landing.

The petitioner's supportive information is as follows:

> "Dassault Aviation hereby petitions for a permanent exemption from the subject rules under Federal Aviation Regulations (FAR) 25.785(b) to enable installation of one or more side-facing sofas in the Falcon 2000 model aircraft. Dassault Aviation offers the

attached information to support this action, along with reasons why this action is in the public interest and will not adversely affect safety.

"Given the criteria against which the Dassault Aviation side-facing sofa has been designed, we believe the occupants of these seats are afforded a level of safety which is equivalent, in all material respects, to the level of safety afforded to other passengers occupying forward- and aft- facing seats which comply with FAR 25.785(b).

"We would also like to point out that, although Dassault Aviation has previously received a permanent exemption [Exemption No. 5991] from meeting the regulatory requirements pertaining to Head Injury Criteria (HIC) in connection with side-facing seats, we believe the design of the sofa which is proposed by Dassault Aviation in connection with this petition, meets such HIC regulatory criteria. This presents an added safety benefit to the occupants of these seats.

The petitioner references the following "Falcon 2000 – Supporting material for petition for exemption from FAR 25.785(b).

"(1) FAA Generic Draft Issue Paper "Dynamic Test Requirements for side-facing Divans" Item CI-1, stage 2 dated 12-Nov-97.
"(2) F2000 Certification Review Item C-11 – Issue 5 dated 24-Mar-99 – Personal injury criteria for dynamic testing of side-facing sofas.
"(3) F2000 Issue Paper CI-1 – Stage 2 dated 25-Nov-94 – Dynamic test requirements for side-facing divans (sofas).
"(4) FAA Exemption No. 5991 – Partial Grant – Issued on 28-Nov-94 (Regulatory Docket 27850).
"(5) FAA Memorandum – Side-facing seats on Transport Category Airplanes – issued by ANM-100 on 19-Nov-97.

"1. AIRPLANE MODEL AND CERTIFICATION BASIS

"1.1 The Falcon 2000 airplane is a twin-jet, swept-wing executive transport with a maximum take-off weight of 36,500 pounds and maximum landing weight of 33,000 pounds.

"1.2 The US certification basis is part 25 of the Federal Aviation Regulations effective February 1, 1965, as amended by Amendment 25-1 through Amendment 25-69. US certification was obtained in February 1995.

"1.3 Certification type to the Joint [Aviation] Requirements [JAR] of the Joint Aviation Authorities [JAA], in accordance with the provisions of JAR 25 included change 13, was granted by the [Direction Generale De L'Aviation Civile] DGAC in November 1994.

"2. STATEMENT OF ISSUE

"When Amendment 25-64 was promulgated, side-facing sofa installations were not adequately taken into account for transport category airplanes.

"Amendment 25-64 revises the emergency landing conditions that must be considered in the design of the airplane: revision of the static load conditions in § 25.561, and addition of a new § 25.562 that requires dynamic testing for all seats approved for occupancy during take-off and landing with a focus on forward-facing seats.

"As the existing regulations do not provide adequate safety standards for occupants of side-facing multiple occupant seats (sofas) and in accordance with the requirements issued in the draft issue paper in reference (1) [above], the certification method proposed by Dassault Aviation for this type of seating is by means of an exemption from the general injury criteria established in FAR 25.785.

"3. PETITION

"Falcon 2000 aircraft model is most often utilized for executive air transportation under parts 91 and 135 of the Federal Aviation Regulations. Due to the nature of the transportation involved, some customers request at least one side-facing sofa when limited to operation under FAR parts 91 and 135. Under 14 CFR part 11.25, Dassault Aviation requests exemption from the following applicable rule: FAR 25.785(b) for side-facing sofas."

"4. JUSTIFICATION AND SAFETY CONSIDERATIONS

"Prior to Amendment 25-64, side-facing seats were not considered a novel design for transport category airplanes. They were routinely approved for installation in compliance with FAR 25.561 and commonly installed on Fan Jet Falcon Series, Mystere Falcon 50, Mystere Falcon 900 and Falcon 900EX airplanes as well as aircraft models produced by other manufacturers.

"Amendment 25-64 included § 25.562, which provides a means of enhancing general occupant protection under more realistic conditions than had previously existed in terms of both test conditions and pass/fail criteria. For multiple occupant side-facing sofas, the FAA has taken the position that these criteria do not provide an equivalent level of safety.

"However, with respect to the Falcon 2000 side-facing sofa JAA certification, a series of dynamic tests have been performed at 'Centre d'Essai Aeronautique de Toulouse' (CEAT – 14g test) and at Civil Aero Medical Institute in Oklahoma City (CAMI – 16g tests). These tests have demonstrated that the Dassault sofa design complies with the injury criteria proposed in the above referenced FAA draft issue paper.

4.1. "Safety considerations

"The results of these Falcon dynamic test are:

"(a) Existing Criteria: The requirements of § 25.562(c)(1) to (4) and (6) are met.

"(b) Body to Body Contact: There is no contact between adjacent occupants.

"(c) Body to Wall/furnishing Contact: Two installation configurations are possible.

"(1) There is no partition with or without furniture forward on the sofa. The tests have shown that there is no contact, body or head, with any aircraft interior installation.

"(2) Installation of a partition, with the trajectory of the head of the forward most passenger.

"We propose to evaluate the HIC, according to § 25.562(c)(5), by a test representative of the second configuration, using an Hybrid III dummy (see paragraph 4.2(c)(1) of this petition).

"(d) Thoracic Trauma: The armrests are relatively low and do not have any significant impact on the thorax. The TTI derived from the test measurement remains well below the value defined in 49 CFR § 571.214.

"(e) Pelvis: The pelvis lateral acceleration remains well below 130g.

"(f) Shoulder Strap Loads: The upper torso restraint strap remains on the occupant's shoulder, and the tension load in the individual strap does not exceed 1750 lb.

"4.2 General guidelines for testing

"The general guidelines contained in the draft issue paper have been applied during the Falcon 2000 dynamic tests.

"(a) All side-facing seats require end closures: The sofa was equipped with armrests at each end limiting each individual seat position.

"(b) All seat positions need to be occupied for longitudinal tests: All 3 seat positions were occupied.

"(c)(1) One test will be required with one [side impact dummy] SID in the forward most position and Hybrid II [Anthropomorphic Test Dummy] ATD(s) in all other positions, with undeformed floor, no yaw, and with all lateral supports (armrests/walls). Two longitudinal tests without floor deformation were performed.

"-- One with 10 degrees yaw, with limiting armrests and with Hybrid III ATD in the forward position, a SID in position 2 and a Hybrid II in position 3, and

"-- One without yaw, with limiting armrests, furniture and wall forward the sofa, and with a SID in the forward position, a Hybrid II ATD in position 2 and a Hybrid III ATD in position 3.

"The selection of different anthropomorphic test dummies in different locations, with or without yaw, was made in order to obtain the maximum amount of information on human injury parameters during side impacts.

"The test analysis shows clearly that the use of a SID is inappropriate for Falcon 2000 business jet sofas (see the rationale in paragraph 4.3 of this petition).

"(c)(2) One test will be required with one SID in the center seat and Hybrid II ATD(s) in all the other positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

"-- One longitudinal test with floor deformation and 10 degrees yaw, with armrests, was performed with a Hybrid III ATD installed in the forward most position and two Hybrid II ATD(s) in positions 2 and 3.

"-- The installation of one SID in the center seat is documented in paragraph 4.2(c)(1) above.

"(d) For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's will be used in all seats positions.

"-- A vertical test was conducted at the CEAT with 3 Hybrid II ATDs.

"Rationale for use of a Hybrid III dummy:

"The Side Impact Dummy (SID) is inappropriate for Falcon 2000 side-facing sofa longitudinal tests, because it does not include any shoulder frame. In a side impact involving an automobile, the restraint of the passenger and the action of the shoulder harness are not considered. When considering Falcon 2000 sofas, the location of the attachment of the shoulder harness i.e. inertia reel, is well below the shoulder level. The

restraint of the upper torso and of the head, in the dummy's lateral direction, is only possible if it is combined with a compression load in the spine. That compression is introduced by the harness in the shoulder structure. The test performed at the CAMI in July 1998, shows clearly that the SID does not react to any load on the shoulder. Therefore, to evaluate the HIC, we propose to use a Hybrid III dummy presenting the same neck and head structure as the SID (same dynamic behavior) and having the ability to react to shoulder loads.

"In conclusion, DASSAULT AVIATION hereby proposes that for FALCON 2000 business jet sofas the SID be replaced by a Hybrid III dummy.

"5. PUBLIC INTEREST

"The importance of business aviation to the well-being of the U.S. economy can not be overstated. Business aviation enables a company to maximize its two most important assets: people and time. For example, business aircraft reduce not only flight time but also total travel time by providing point to point service and their ability to utilize smaller airports closer to final destinations. In addition, the 'office' environment which exists within the business aircraft allows travel time of busy executives and their guests, to become productive time.

"Very often, conversations conducted on business aircraft are confidential and deal with commercially sensitive matters. Accordingly, owners of business aircraft strongly prefer to configure their cabins is such a way that special requirements of their operation can be met. One of the most popular configurations requested by a wide array of business and public sector customers is a split cabin configuration where one sector is devoted to club seating used for individual work areas and dining areas while the second sector is devoted to private meetings and/or a rest area set off from the remainder of the cabin.

"Over the years, it has been determined that the most efficient means to configure private meeting/rest area is to install a side-facing multi seat divan (sofa) which serves the dual purpose of providing seating for private meetings and which has the capability to be converted to a comfortable rest area during the course of the flight. Moreover, it has also been established that this configuration, provides the best possible seating arrangement for physically handicapped and/or ill passengers who require the ability to lay in a semi or full supine position during portions of the flight in order to maintain an acceptable level of comfort. Finally, this configuration also allows augmented flight crews to rest during the course of long haul flights in an area which is separated from the remainder of the cabin and which permits other passengers to continue their work undisturbed. The importance of having such a suitable rest area for augmented crews has been highlighted by such notable organizations as the Flight Safety Foundation and the FAA in order to ensure that the highest level of safety is maintained during long haul and/or multiple leg flights.

"The granting of this exemption will permit the most efficient use of the aircraft cabin for business meetings and other commercial activities which will significantly enhance the

value of the aircraft to its owner/operator. Further, the granting of the petition will allow better and more comfortable rest area accommodations for busy executives and physically challenged passengers as well as crewmembers who require rest in order to perform their flight duties in a safe and alert manner."

A summary of the petition was published in the Federal Register on September 9, 1999 (64 FR 49042). No comments were received.

The Federal Aviation Administration's analysis/summary is as follows:

Background

The applicant's petition for exemption from § 25.785(b) is based on the FAA Memorandum, Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997. This memorandum provides dynamic test condition requirements and pass/fail criteria for side-facing seats on transport category airplanes.

Amendment 25-64, which adopted § 25.562, provides a means of enhancing general occupant protection under more realistic conditions than previously existed.

Amendment 25-72 relocated some of requirements of § 25.785, including the general occupant protection requirements in § 25.785(a). At Amendment 25-72, the general occupant protection requirements are in § 25.785(b). Therefore, the petition for exemption is from § 25.785(a) at Amendment 25-64.

The certification basis of the Falcon 2000, however, is part 25 through Amendment 25-69.

The FAA Memorandum: Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997, provides:

(1) The dynamic test conditions criteria. In terms of both pulse severity and types of tests currently required, these criteria are also considered directly applicable to side-facing seats. While it is true that the regulation was written with forward- and aft-facing seats in mind, the orientation of the seat does not change the relevant test conditions.

(2) The pass/fail criteria. For these criteria, however, the orientation of the seat may be significant. Injury criteria are currently limited to head, spine, and femur loads. Head impact is evaluated for contact experienced by the head against any aircraft interior installations, and the pass/fail criterion is based on the resultant head acceleration considering all axes of head motion. The lumbar spinal load is an axially compressive

load that is primarily evaluated during the 14g, 60 degree test. The femur load is also compressive, and actually has not proved to be critical thus far. For a side-facing seat, other injury parameters may predominate such that evaluation of those parameters may be necessary to provide an acceptable level of safety.

The first consideration for a side-facing seat is the isolation of one occupant from another. That is, occupants should not rely on the impact with other occupants to provide energy absorption; body-to-body impacts are considered unacceptable.

The second consideration for a side-facing seat is the retention of occupants in the seat and restraint system. Addressing this concern may necessitate providing a means of restraint for the lower limbs as well as the torso. Failure to limit the forward (in the airplane's coordinate system) travel of the lower limbs can cause the occupant to come out of the restraint system or produce severe injuries due to the resulting position of the restraint system, and/or twisting (torsional load) of the lower lumbar spinal column.

The third consideration for a side-facing seat is limiting the load in the torso in the lateral direction, where human tolerance differs from that for the forward- or aft-facing directions and where potential injury mechanisms exist. The automotive industry has developed test procedures and occupant injury criteria appropriate for side impact conditions. Their criteria involve limitation of lateral pelvic accelerations and use of the human tolerance parameter "Thoracic Trauma Index," which is defined in 49 CFR § 571.214. Use of the 49 CFR § 572, subpart F, Side Impact Dummy (SID), rather than the 49 CFR § 572, subpart B, Hybrid II Dummy used in the 14 CFR § 25.562 test, is required to evaluate these parameters. This is the best means available, at present, to assess the injury potential of a sideward impact condition. Such an evaluation is considered necessary to provide an acceptable level of safety for these types of seats.

Other potential injury mechanisms appropriate for aircraft seats may exist. However, due to the lack of useful injury criteria for those other potential injury parameters, such as neck loads and lower limb flail, the FAA is not able to specify criteria applicable to those areas at this time. The FAA considers that such criteria may be appropriate, particularly for multiple occupancy installations, and intends to pursue their further development.

For multiple occupancy seating, the best criteria currently available cannot be said to provide an equivalent level of safety for those occupants. Therefore, the only vehicle available for accepting these installations would be through an exemption from the general occupant protection requirements of § 25.785(a) prior to Amendment 25-72, or § 25.785(b) after Amendment 25-72.

A summary of the criteria from the FAA Memorandum, Side-Facing Seats on Transport Category Airplanes, dated November 19, 1997, provides the basis of the petition for exemption.

1. Proposed Injury Criteria

(a) Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. Head injury criteria (HIC) assessments are only required for head contact with the seat and/or adjacent structures.

(b) Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one seated Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the test conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental contact of the legs, feet, arms and hands that will not result in incapacitation of the occupants is acceptable. Contact during rebound is allowed.

(c) Body-to-Wall/furnishing Contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

(d) Thoracic Trauma: Testing with a Side Impact Dummy (SID), as defined by 49 CFR part 572, subpart F, or its equivalent, must be conducted and Thoracic Trauma Index (TTI) injury criteria acquired with the SID must be less than 85, as defined in 49 CFR part 572, subpart F. Side impact dummy TTI data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) part 571.214, section S6.13.5.

(e) Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS part 571.214, section S6.13.5.

(f) Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

2. General Guidelines

(a) All side-facing seats require end closures.

(b) All seat positions need to be occupied for the longitudinal tests.

(c) For the longitudinal tests, conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of sets will be required as follows:

(1) One test will be required with one SID ATD in the forward most position and Hybrid II ATD(s) in all other positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls).

(2) One test will be required with one SID ATD in the center seat and Hybrid II ATD(s) in all other positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

(d) For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's will be used in all seat positions.

The petitioner proposes using a Hybrid III ATD for the HIC testing in place of the SID ATD. The design of the seat and restraint system for the Falcon 2000 results in a compressive load being applied to the shoulder of the ATD. The SID ATD does not react to this load because the SID does not have shoulder structure. This is documented in testing that was conducted at CAMI in July 1998. The FAA agrees with the petitioner that the SID ATD should be replaced for the Falcon 2000 seat and restraint design. The FAA, however, does not agree that the Hybrid III ATD should be used. The SID ATD can be replaced by the Hybrid II ATD or equivalent for the proposed design.

The petitioner notes that the Falcon 2000 was granted an exemption from § 25.562(c)(5) by FAA Exemption No. 5991, dated November 28, 1994. Since the granting of Exemption No. 5991, the petitioner has developed new designs of seats and restraint systems that can comply with the requirements of § 25.562(c)(5). The petitioner proposes demonstrating compliance with the requirements of § 25.562(c)(5) as part of the exemption from § 25.785(a).

The FAA may refine the compliance criteria for multiple occupancy side-facing seating to establish an equivalent level of safety. This may include additional injury criteria related to neck loads or other injury mechanisms. The guidance will be updated accordingly, and the certification of multiple occupancy seating may be processed with special conditions in lieu of exemptions. Therefore, the FAA does not agree with the petitioner's request for exemption for all Falcon 2000 airplanes. The FAA will grant an exemption that will cover airplanes that are manufactured for a specific amount of time. During this time, the FAA may refine the compliance criteria for multiple occupancy side-facing seating.

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not affect the level of safety provided by the regulations. Therefore, pursuant to the authority
contained in § 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator (14 CFR 11.53), Dassault Aviation is hereby granted an exemption from the requirements of § 25.785(a) Amendment 25-64, for the general occupant protection requirements for occupants of multiple place side-facing seats that are occupied during takeoff and landing for Falcon 2000 airplanes manufactured prior to January 1, 2004.

The following limitations apply to this exemption:

1. Existing Criteria: All injury protection criteria of § 25.562(c)(1) through (c)(6) apply to the occupants of side-facing seating. The HIC assessments are only required for head contact with the seat and/or adjacent structures.

2. Body-to-Body Contact: Contact between the head, pelvis, or shoulder area of one Anthropomorphic Test Dummy (ATD) on the adjacent seated ATD's is not allowed during the test conducted in accordance with § 25.562(b)(1) and (b)(2). Incidental contact of the legs, feet, arms and hands that will not result in incapacitation of the occupants is acceptable. Any contact between adjacent ATD's is acceptable during rebound.

3. Body-to-Wall/furnishing Contact: If the sofa is installed aft of a structure such as an interior wall or furnishing that may contact the pelvis, upper arm, chest, or head of an occupant seated next to the structure, then a conservative representation of the structure and its stiffness must be included in the tests. In most cases, the representation of the structure would be more rigid and have less deflection under load than the actual installation on the airplanes. The contact surface of this structure must be covered with at least two inches of energy absorbing protective foam, such as ensolite.

4. Thoracic Trauma: Thoracic Trauma Index (TTI) injury criteria must be less than 85, as defined in 49 CFR part 572, subpart F. Thoracic trauma index data must be processed as defined in Federal Motor Vehicle Safety Standard (FMVSS) part 571.214, section S6.13.5.

5. Pelvis: Pelvic lateral acceleration must not exceed 130g. Pelvic acceleration data must be processed as defined in FMVSS part 571.214, section S6.13.5.

6. Shoulder Strap Loads: Where upper torso straps (shoulder straps) are used for sofa occupants, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

7. Seat Positions: All seat positions need to be occupied by ATD's for the longitudinal tests.

8. End Closures: All side facing seats require end closures or other means to prevent the occupant from translating off of the seat.

9. Longitudinal Tests: For the longitudinal tests conducted in accordance with the conditions specified in § 25.562(b)(2), a minimum number of tests will be required as follows:

a. One test will be required with ATD's in all positions, with undeformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). For configurations with a wall or bulkhead immediately forward of the forward seat position on the sofa, a SID ATD will be used in the forward seat position and a Hybrid II ATD(s) or equivalent will be used for all other seat locations. For configurations without a wall or bulkhead immediately forward of the forward seat, Hybrid II ATD's or equivalent will be used in all seat locations.

b. One test will be required with Hybrid II ATD's or equivalent in all positions, with deformed floor, 10 degrees yaw, and with all lateral supports (armrests/walls). This could be considered the structural test as well.

10. Vertical Test: For the vertical test, conducted in accordance with the conditions specified in § 25.562(b)(1), Hybrid II ATD's or equivalent will be used in all seat positions.

Issued in Renton Washington, on January 18, 2000.

/s/ Donald L. Riggin
Donald L. Riggin
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service, ANM-100